

# **BRYAN / COLLEGE STATION UNIFORM DESIGN GUIDELINES**

**Sanitary Sewer**

# SANITARY SEWER

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## **GENERAL:**

The purpose of this manual is to establish certain minimum criteria for the design of wastewater collection mains in the Cities' jurisdiction. It is intended to be used by the city staff and private consulting engineers for all new utility construction, replacements and modifications to the existing systems. Unusual circumstances or special designs requiring exception from the standards in this manual must be approved by the City Engineer.

This manual is intended to be used in conjunction with all current American Water Works Association (AWWA) and Texas Commission on Environmental Quality (TCEQ) requirements. In the case of a conflict between this manual and either or both of these other requirements, the most restrictive will govern.

The criteria outlined in this manual are also intended to be used in conjunction with the Cities' Unified Technical Specifications.

For the purpose of this manual, wastewater collection mains are those mains of 18 inches in diameter or smaller. Larger diameter mains are considered to be interceptor or transmission mains and are subject to additional design criteria and review.

Proposed wastewater collection systems that accept flows from existing upstream sewers shall be designed to accommodate all flows generated by the upstream service area. The existing upstream sewers may experience variable peak flows greater than the peaks utilized in the design of new sewers. The peak flow rates (particularly the infiltration/inflow rates) for each existing subsystem is highly variable. Consult with the City Engineering Services Department to confirm the proper peak flow rates to be used for any existing upstream wastewater collection system. The proposed wastewater collection system design shall include a review of all existing downstream sewers receiving flow from the proposed sewers to verify that flows generated from the proposed wastewater collection system do not adversely affect the performance of the downstream systems.

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## Submittal Requirements

The design engineer shall submit the following information with all wastewater system designs:

- Plan and profile sheets containing all information necessary to review, construct and inspect the improvements. This shall include a traffic control plan as applicable
- Wastewater Design Report showing that the design of the proposed improvements meet the flow requirements of this manual.
- Copy of information provided to TCEQ in compliance with TCEQ submittal requirements (TAC317) for City records purposes. If the project is exempted from TCEQ submittal, this submittal to the City is also exempted.

## Special Designs

The City Engineer may, upon request, approve an alternate design or construction methodology that differs from the requirements in this manual if the City Engineer determines that : (1) the alternative design or construction methodology is equivalent to, or superior to, the methodology required in this manual, and (2) the alternative design or construction methodology is sufficient to ensure public health and safety..

Lift station design shall follow acceptable engineering practices and be reviewed by City staff.

## Connections

All residential connections and service leads shall be installed to both sides of all roads and alleys at the time of main line installation.

Service connections shall be tied into the main line.

## PIPE SELECTION:

Pipes shall be designed to provide a safe, efficient and maintainable system for the collection of wastewater from its various sources of generation to the existing collection and interceptor systems.

## Pipe Materials

The following pipe materials may be specified for wastewater, collection, and force mains as well as service lines within the City's rights-of-ways.

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Ductile iron pipe (DIP), pressure class 350 for sizes 6 through 12 inches and pressure class 250 for sizes greater than 12 inches. Force mains shall be DIP, pressure class 350 or ASTM D2241 pressure class 160 and shall not be greater in size than 8 inches.

Polyvinyl chloride pipe (PVC) and all fittings shall be SDR26-ASTM D3034 in sizes 6 through 12 inches and SDR26-ASTM D2241 for larger sizes. PVC pipe will not be permitted for aerial crossings.

For material information on pipe encasements refer to the "Encasements" section of this document.

Changes in pipe material shall only occur at manholes with the exception of short replacements of sewer lines needed to meet TCEQ separation requirements.

## Pipe Sizing

Pipes and pipe systems shall be designed to provide the service criteria listed below.

## Standard Pipe Sizes

The standard pipe sizes for wastewater collection mains are 6, 8, 10, 12, and 18 inches in diameter. Standard service leads shall not be more than 150 feet in length and shall terminate in a cleanout at the property line.

## Minimum Pipe Sizes

Minimum wastewater pipe sizes shall be as follows:

- Collection Mains – 6 inches
- Residential Service Leads – 4 inches (single & double)
- Commercial Service Leads – 6 inches (single only)

## Flow Requirements

Wastewater collection mains shall be sized to meet all of the following requirements using an analysis method based on Manning's equation.

## Flow Calculation

One of the following three methods shall be used to determine the peak hourly flows by which a new wastewater system at the fringes of the existing system is to be designed (For new systems being developed within the existing system, consult the Wastewater Master Plan for design criteria). In each method, the following equations apply:

Peak Hourly Flow = (Average Daily Flow)(4)

- Method 1 - Fixture Count Determination

For multi-family residential, institutional, commercial and industrial uses, the “fixture unit” method of estimating peak wastewater generation may be used in accordance with the current duly adopted City Plumbing Code. Table I shows a fixture unit value for various plumbing fixtures and groups of fixtures. Table II shows the probable peak rate of flow generation from systems consisting of various numbers of fixture units.

- Method 2 – Land Use Determination

Table III contains the average daily flow per capita to be expected from a variety of uses.

The population factor for residential land uses is 2.67 persons per unit, which is then applied to the actual number of units per acre if known, or the maximum units per acre from the current land use plan if the property development is not yet finalized.

The population factors for non-residential uses are 30 persons per acre for commercial, office and institutional uses and 15 persons per acre for Industrial uses.

- Method 3 - Gross Area Determination

If beyond the boundaries of the current Wastewater Master Plan and/or in the absence of projected land uses, the average daily flow per acre contained in Table IV may be used.

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- Method 4 – Historical Data

If there is information regarding average daily flows for a particular type of development that is more accurate than the data from the other methods, the historic information may be used. Please discuss this with the City prior to using so as to ensure the information is acceptable.

**System Design Criteria** Wastewater mains and collection lines shall be designed to carry the peak daily load estimated from the tributary areas when fully developed to the current land use plan. Determination of peak loadings shall be based on an analysis of the density and character of the land uses in the tributary area and the probable wastewater generation from those uses.

## MINIMUM / MAXIMUM PIPE SLOPES

PIPE SIZE	SLOPE (%)	
	MINIMUM	MAXIMUM
6"	0.80	7.80
8"	0.40	5.30
10"	0.30	3.90
12"	0.25	3.10
18"	0.20	1.80
24"	0.20	1.20
30"	0.20	0.90
36"	0.20	0.70

For lines larger than 36 inches in diameter, the slope may be determined by Manning's formula to maintain a minimum velocity greater than 2.5 feet per second when flowing full and a maximum velocity less than 8 feet per second when flowing full when using a Manning's "n" of 0.013.

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Pipe velocities should be consistent between manholes and avoid abrupt reductions in velocity.

## **PIPE ALIGNMENT:**

The design of the wastewater collection mains should provide economical access for maintenance and repair, reliability of location and minimum disruption to surrounding facilities during repair operations. In all cases wastewater facilities shall comply with TCEQ requirements.

### Horizontal Layout

Wastewater mains and collection lines should be laid straight between manholes and at a uniform distance from the right-of-way line.

The centerline of wastewater mains and collection lines constructed in street rights-of-way shall be located as shown on the Typical Utility Location Detail (Figures 9 and 10 in the streets section), on the opposite side of the street from the water main.

### Vertical Layout

The desired minimum cover for sanitary sewer pipe shall be six feet (6') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation. When it is necessary to reduce the cover, the design shall include ductile iron pipe and may include cement stabilized sand backfill for covers less than 3.5'. Any shallow depth sewer lines shall be discussed with the City Engineer.

Wastewater mains and laterals should be laid on a straight grade between manholes while avoiding excessive depths. Elevations must be shown on construction plans at 100-foot stations and at all manholes and match marks. Elevations are to be calculated to the nearest 0.01 foot.

Wastewater mains and collection lines must be constructed to a depth which will insure gravity flow in service connections to adjacent properties. In general, this is accomplished by setting a 2% grade from the centerline of the collection main to a point one (1) foot below floor elevation at the building line of the structure being served. The service lead must have a minimum cover of 2 feet at its shallowest point including roadside drainage ditches where present.

### Separation From Water Facilities

Separation of public water and wastewater mains will be consistent with the current Rules and Regulations for Public Water Systems of the TCEQ.

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## MANHOLES:

Manholes will be required at changes in horizontal alignment, changes in grade, changes in pipe size and junctions with other wastewater mains or collection lines. Manholes will not be required at the junctions where service leads join mains.

When connecting new sewer lines into existing manholes, the City will provide a point of connection.

The maximum distance between manholes shall be as per the requirements of TCEQ.

When a change in the size of a wastewater main or collection line occurs without a change in grade, the inside top of pipe (soffit) elevations will be matched in the manhole. Elevation differences between pipes at a manhole may require a drop manhole (see TCEQ for more information).

At the end of a main or collection line, the line shall be terminated with a manhole or clean out as per TCEQ requirements. If an extension is anticipated, a plugged stub-out of one full pipe joint with a clean-out is required.

Manholes may be constructed of fiberglass or concrete. Concrete manhole may be cast in place or precast. Fiberglass manholes may only be used in non-structural areas as a special design.

Manhole sizes shall be as follows:

<u>Manhole Diameter</u>	<u>Main Size</u>
4 ft	<18 in.
5 ft	≥18 in. < 30 in.
6 ft	≥36 in.

## RIGHT-OF-WAY CROSSINGS:

Wastewater collection mains that cross state highways must conform to the Cities' Unified Technical Specifications and the requirements of the Texas Department of Transportation (TxDOT).

Wastewater collection mains that cross railroads must conform to the Cities' Unified Technical Specifications and the requirements of the railroad company whose right-of-way is being crossed.

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For wastewater collection mains crossing creeks or drainage channels, piers must support the elevated sections of such crossings.

Below grade crossings of creeks and drainage channels shall have a minimum cover of 3.5 feet below the flowline at the time of construction or shall be constructed of ductile iron pipe. Another option is to adequately protect the pipe from stream erosion by concrete encasement or other approved means. See more specific information in Specification 400.

Dry bore all crossings of existing streets unless otherwise authorized by the City Engineer.

## **ENCASEMENTS:**

Steel cylinder pipe shall be used for all encasement pipe. Other encasement pipe material may be used per TCEQ requirements and City Specifications. Carrier pipes sized 30 inches or less shall use an encasement pipe with a wall thickness no less than 3/8-inch. For larger carrier pipes, a wall thickness of no less than 1/2-inch shall be used. Coating of encasement pipe may be required in special soil conditions.

Pipe encasement will be required for all wastewater collection mains crossing any existing street and on new streets classified as major collector or greater. This does not apply to services. Special field conditions may require an alternate method of installation, which must be approved by the City Engineer.

Encasement pipe diameter shall be as specified in the Technical Specifications. Encasement pipes shall extend 2 feet beyond the back of both curbs on the street. Ends of encasement pipes shall be sealed to prevent the intrusion and collection of groundwater.

All carrier pipes will be supported by Cascade carriers (or approved equal), that will allow the removal of the carrier pipe from the encasement pipe in a single direction by means of tension on the carrier pipe only.

## **EASEMENTS:**

Wastewater lines constructed outside of public rights-of-way shall be in easements of not less than 15 feet in width unless sewer main bury is deeper than 4 feet, in which case, easement width shall be increased to 20 feet. If both water and wastewater mains are located within the same easement, the width shall be not less than 20 feet unless either main is buried deeper than 14 feet, in which case, easement width shall be increased to 30 feet.

The easement must be located such that the centerline of the wastewater line is no closer than 5.5 feet to the closest edge of the easement.

Wastewater collection mains constructed adjacent to TxDOT maintained roadways shall be located in a utility easement. The main may be allowed within a utility accommodation zone provided by TxDOT on a case by case basis.

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**TABLE I**  
**FIXTURE UNITS PER UNIT OR GROUP**

FIXTURE TYPE	FIXTURE UNIT VALUE LOAD FACTOR
One Bathroom Group – tank operated water closet, tub or shower, lavatory	6
Bathtub (with or without shower)	2
Dishwater (domestic)	2
Kitchen Sink	1
With food grinder	2
Lavatory	2
Shower Group, per head	3
Sinks, commercial	
-Surgeon's	3
-Flushing Rim (with valve)	8
-Service	3
-Pot (scullery, etc.)	4
Urinals	4
Washer, clothes	4
Water Closets	
-Tank Operated	4
-Valve Operated	8

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**TABLE II  
PEAK WASTEWATER FLOWS BASED ON FIXTURE UNITS**

FIXTURE UNITS	PEAK DEMAND (GPM)
500	125
1000	215
1500	300
2000	330
2500	380
3000	420
3500	490
4000	560
4500	630
5000	700
6000	840
7000	980
8000	1120
9000	1260
10000	1330

**TABLE III  
AVERAGE WASTEWATER GENERATIONS**

USE	AVERAGE FLOW GPD/CAP
Residential	100
Commercial	
-Office	50
-Retail	25
-Hotel/Motel	150
Institutional	
-Schools	35
-Hospitals	200
Industrial	50

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**TABLE IV  
AVERAGE DAILY DESIGN FLOWS**

<b>TRIBUTARY AREA (Acres)</b>	<b>DESIGN DEMAND (g.p.d. per acre)</b>
Less than 250	7000
250-300	6500
300-500	6000
500-1000	5500
1000-2000	5000
2000-3000	4500
More than 3000	4000